



CFOSAT Scatterometer NRT and L2A Products
Format Specification
Version 3.3

National Satellite Ocean Application Service

October 21, 2021

CHANGES

Version	Rev.	Date	History
01	00	2018-01-20	Document created by Wenming Lin
01	01	2018-08-02	Update by Wenming Lin
01	02	2018-09-11	Update the L2A specification
02	00	2019-09-30	Check the consistency between DOC and PROC
03	03	2021-10-21	Consistency check

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1 OVERVIEW

1.1 SCOPE

This document defines the files format of the CFOSAT scatterometer (CFOSCAT) near-real-time (NRT) wind product and level 2A product, which are generated by the CFOSCAT L2 processor installed at CNES in the context of the exchange of L2 processors between CNES and NSOAS.

1.2 DOCUMENT OVERVIEW

Chapter 1 provides the list of reference and applicable documents.

Chapter 2 describes the general file features.

Chapter 3 and 4 present detailed descriptions on the variables included in the NRT and the L2A products respectively.

1.3 REFERENCE DOCUMENTS

CF-1090 CFOSAT Ground Segment File Format Definition

CF-1090-AnnexeA

1.4 APPLICABLE DOCUMENTS

FFS-ESA Earth Observation - Ground Segment - File Format Standard ESA, 07/03/2011, Issue 2, Rev. 0
PE-TN-ESA-GS-0001

CF-1-7 NetCDF Climate and Forecast Metadata Conventions 28/03/2014, Issue 1, Rev. 7

2 GENERAL FILE FEATURES

2.1 INTRODUCTION

2.1.1 NAMING

According to the reference and the applicable documents, the NRT wind product is named using below the format:

- [CFO_OPER_SCA_NRT____F_YYYYMMDDThhmmss_YYYYMMDDThhmmss.nc](#)

And the L2A radar backscatter product is named as follow:

- [CFO_OPER_SCA_L2A____F_YYYYMMDDThhmmss_YYYYMMDDThhmmss.nc](#)

where the two fields 'YYYYMMDDThhmmss' represent the start and stop time of the observations included in the file.

2.1.2 FILE FORMAT

The NRT wind product and the L2A radar backscatter product are both with NetCDF (Network Common Data Form, defined by the Unidata group) format based on the stable version netcdf-4. Each NetCDF file consists of two parts:

- a metadata block, which lists :
 - o the global attributes that provide general information of the file,
 - o the variables (the parameters) that provide a precise description of each ones using attributes,
- a data block : it stores the values of a variable.

The structure is based on the netCDF-4 data model. The file is created with the **NC_CLASSIC_MODEL** flag.

2.2 GLOBAL ATTRIBUTES

Global attributes are used to hold information which applies to the whole file, such as the data set title. They are defined in the metadata block and provide general information about the file and its content. The table below defines the global attributes for both the NRT wind product and the L2A backscatter product.

ID	Tag name	Format	Description
1	Conventions	string	A text string identifying the netCDF convention followed. This attribute should be set to "CF-1.7" to indicate compatibility with the Climate and Forecast CF-1.7
2	title	string	A descriptive title for the file
3	institution	string	CNES
4	references	string	References that describe the data or the methods used to produce it.
5	contact	string	A free text string giving the primary contact for information about the data set
6	netcdf_version_id	string	Version of the NetCDF library
7	date_created	string, ISO 8601 format "yyyy-mm-ddThh:mm:ss Z"	Date the data file was created (UTC)
8	generator_center	string	Name of the main generator center : "FROGS"
9	generator_subcenter	string	Name of the generator subcenter, such as

			CWWIC
10	product_version	string	Release number of the data file : “<x>.<y>” where xx is editing and yy is review, such 3.3
11	history	string	List of the applications that have modified the original data
12	platform	string	Satellite identifier : "CFOSAT"
13	sensor	string	Sensor identifier : "SCAT"
14	geospatial_lon_resolution	string	Product resolution of the longitude coordinate (approximate value)
15	geospatial_lat_resolution	string	Product resolution of the latitude coordinate (approximate value)
16	time_coverage_start	string	Describes the temporal coverage start of the data follow ISO 8601
17	time_coverage_end	string	Describes the temporal coverage end of the data follow ISO 8601
18	time_coverage_duration	string	Describes the temporal coverage of the data as a time range. follow ISO 8601
19	geospatial_lat_max	Float	In degrees north, range -90° to +90°
20	geospatial_lat_min	Float	In degrees north, range -90° to +90°
21	geospatial_lon_max	Float	In degrees east, range -180° to +180°, the reference is the greenwhich meridian
22	geospatial_lon_min	Float	In degrees east, range -180° to +180°, the reference is the greenwhich meridian
23	file_quality_index	integer	A code value : 0 : unknown quality 1 : excellent (no known problems) 2 : suspect (occasional problems)
24	comment	string	Miscellaneous information
25	processing_level	string	This attribute should also identify the authority which defined the processing level along with the processing level itself.
26	publisher_email	string	The email address of the person or group that distributes the data files.
27	pubisher_name	string	Name of the person or group that distributes the data files. Use the conventions described above when identifying persons and/or institutions when applicable.
28	publisher_url	string	URL of the person or group that distributes the data files.
29	summary	string	Description of the data contained within the file, expanding on the title to provide more information.
30	cycle	string	Number of the cycle (CFOSAT cycle duration is about 13 days) and associated dates. Format

			is a succession of string (with “/” separator) like “<number>_<start_date>_<stop_date> Where number a 3 characters string Start_date and stop_date are ISO 8601 date
31	trace	string	Revolution number Same format as cycle parameter
32	start_orbit_number	Integer	Orbit number of the first measurement
33	stop_orbit_number	Integer	Orbit number of the last measurement
34	equator_crossing_longitude	Float	Longitude when satellite orbit crosses equator
35	equator_crossing_date	string, ISO 8601 format	Date when satellite orbit crosses equator
36	ground_station	String 3 character	Short name of the ground station, ex for Inuvik = IVK
37	input_files	string	List of input files used to generate the current netCDF file.

Note: The information on ‘cycle’, ‘trace’, ‘start_orbit_number’, and ‘stop_orbit_number’ is simply copied from the input L1B file.

2.3 VARIABLE ATTRIBUTES

The table below gives the available attribute list for the definition of the NRT wind product and the L2A backscatter product.

Tag Name	Mandatory	Format	Description
_FillValue	Y	Depends on variable type	A value used to indicate array elements containing no valid data. This must be of the same type than the storage (packed) type; should be set as the minimum value for this type.
units	Y	string	Text description of the units, preferably S.I., and must be compatible with the Unidata UDUNITS package. For a given variable (e.g. wind speed), these must be the same for each dataset.
scale_factor	Y	double	A value used to adapt the dynamic range of the corresponding variable, such that the variable can be stored in other data type for the sake of saving data volume.
long_name	Y	string	A long version of the variable name
valid_min	Y	Depends on variable type	Minimum valid value for this variable once they are packed (in storage type). The fill value should be outside this valid range.

valid_max	Y	Depends on variable type	Maximum valid value for this variable once they are packed (in storage type). The fill value should be outside this valid range.
source	Y	string	Method of production of the original data or original provider.
comment	Y	string	Miscellaneous information about the data or the methods used to produce it.
references	Y	string	Should point to project web sites, published papers, and similar items.

3 CFOSCAT NRT WIND PRODUCT

3.1 DEFINITION OF ARRAY DIMENSIONS

The array dimensions of the NRT variables are defined as follows:

- numambigs = 4 – the maximum number of wind ambiguities saved in the file.
- numcells = 42 -- the number of wind vector cells per row. The WVC grid resolution is 25 km.
- numrows = 1800, the maximum number of WVC rows.
- numtime = 20 – the string length of the observation time.

3.2 VARIABLES

The NRT wind product includes a set of variables (parameters) defined in the following table.

ID	Variable Name	Definition	Type	Dimension
1	row_time	Observation time of each WVC row	char	numtime × numrows
2	wvc_lat	WVC latitude	Short	numcells × numrows
3	wvc_lon	WVC longitude	Short	numcells × numrows
4	wvc_quality	WVC quality flag	Int	numcells × numrows
5	model_speed	Model wind speed	Short	numcells × numrows
6	model_dir	Model wind direction	Short	numcells × numrows
7	wind_speed_selection	Selected wind speed by the ambiguity removal process	Short	numcells × numrows
8	wind_dir_selection	Selected wind direction by the	Short	numcells × numrows

		ambiguity removal process		
9	wvc_selection	Selected ambiguity index	Byte	numcells $\times$ numrows
10	num_ambigs	Number of wind ambiguities	Byte	numcells $\times$ numrows
11	wind_u_err	Estimated SD error of the wind u component	Short	numcells $\times$ numrows
12	wind_v_err	Estimated SD error of the wind v component	Short	numcells $\times$ numrows
13	rain_prob	The probability of rain contamination	Short	numcells $\times$ numrows
14	wvc_se	WVC singularity exponent	Short	numcells $\times$ numrows
15	max_likelihood_est	Inversion residual of the maximum likelihood estimator	Short	numambigs $\times$ numcells $\times$ numrows
16	wind_speed	Retrieved wind speed of the ambiguity solitons	Short	numambigs $\times$ numcells $\times$ numrows
17	wind_dir	Retrieved wind direction of the ambiguity solutions	Short	numambigs $\times$ numcells $\times$ numrows

The valid range of each variable is shown in the following table.

Variable Name	Valid Range	FillValue	Scale
row_time	2000-01-01T00:00:00Z 2099-12-31T23:59:59Z	N/A	N/A
wvc_lat	[-9000 9000]	-32768	0.01
wvc_lon	[-18000 18000]	-32768	0.01
wvc_quality	[0 2147483646]	-2147483648	1
model_speed	[0 5000]	-32768	0.01
model_dir	[0 3600]	-32768	0.1
wind_speed_selection	[0 5000]	-32768	0.01
wind_dir_selection	[0 3600]	-32768	0.1
wvc_selection	[1 4]	-128	1
num_ambigs	[0 4]	-128	1
wind_u_err	[0 1000]	-32768	0.01
wind_v_err	[0 1000]	-32768	0.01
rain_prob	[0 10000]	-32768	0.01

wvc_se	[-1000 1000]	-32768	0.001
max_likelihood_est	[-30000 30000]	-32768	0.01
wind_speed	[0 5000]	-32768	0.01
wind_dir	[0 3600]	-32768	0.1

The variable wvc_quality consists of a set of useful flags, as shown in the following table.

Bit	Name	Definition
22	qual_sigma0	One or more sigma0s have poor quality
21	azimuth	Poor azimuth diversity
20	kp	Any beam noise content above threshold
19	monflag	Product monitoring not used
18	monvalue	Product monitoring event flag
17	knmi_qc	KNMI Quality Control data rejection
16	var_qc	Variational Quality Control data rejection
15	land	Some portion of WVC over land
14	ice	Some portion of WVC over ice
13	inversion	Wind inversion not successful
12	large	Large wind (greater than 30 m/s)
11	small	Small wind (less than or equal to 3 m/s)
10	rain_fail	Rain flag not usable
9	rain_detect	Rain detected
8	no_background	No meteorological background used
7	redundant	Data is redundant
6	gmf_distance	Distance to GMF too large
5	full_beam	One of the 16 beams is missing
4	morethan_2	More than two beams are available
Others	Reserved	Default

4 CFOSCAT L2A BACKSCATTER PRODUCT

4.1 DEFINITION OF ARRAY DIMENSIONS

The array dimensions of the L2A variables are defined as follows:

- numviews = 16 – the maximum number of views (by aggregating slices with similar incidence and azimuth angles) saved in the file.
- numcells = 42 -- the number of wind vector cells per row. The WVC grid resolution is 25 km.
- numrows = 1800 -- the max number of WVC rows.
- numtime = 20 – the string length of the observation time.

4.2 VARIABLES

The L2A radar backscatter product includes a set of variables (parameters) defined in the following table.

ID	Variable Name	Definition	Type	Diemnsion
1	row_time	Observation time of each WVC row	char	numtime × numrows
2	wvc_lat	WVC latitude	Short	numcells × numrows
3	wvc_lon	WVC longitude	Short	numcells × numrows
4	wvc_quality	WVC quality flag	Int	numcells × numrows
5	wvc_attenuation	Atmospheric attenuation factor	Short	numviews × numcells × numrows
6	wvc_sigma0	WVC sigma0 after aggregation	Short	numviews × numcells × numrows
7	wvc_azimuth	WVC azimuth angles	Short	numviews × numcells × numrows
8	wvc_incidence	WVC incidence angles	Short	numviews × numcells × numrows
9	wvc_kpa	Kpa of the measured sigma0	Float	numviews × numcells × numrows
10	wvc_kpb	Kpb of the measured sigma0	Float	numviews × numcells × numrows
11	wvc_kpc	Kpc of the measured sigma0	Float	numviews × numcells × numrows
12	sigma0_flag	sigma0 flag	Int	numviews × numcells × numrows

13	antenna_azimuth	Antenna azimuth angles	Short	numviews × numcells × numrows
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The valid range of each variable is shown in the following table.

Variable Name	Valid Range	FillValue	Scale
row_time	2000-01-01T00:00:00Z 2099-12-31T23:59:59Z	0000-00-00T00:00:00Z	N/A
wvc_lat	[-9000 9000]	-32768	0.01
wvc_lon	[-18000 18000]	-32768	0.01
wvc_quality	[0 2147483646]	-2147483648	1
wvc_attenuation	[0 10000]	-32768	0.001
wvc_sigma0	[-10000 10000]	-32768	0.01
wvc_azimuth	[0 3600]	-32768	0.1
wvc_incidence	[1600 6600]	-32768	0.01
wvc_kpa	[1.0 2.0]	-1.7E38	1.0
wvc_kpb	[0.0 0.001]	-1.7E38	1.0
wvc_kpc	[-150 0.0]	-1.7E38	1.0
antenna_azimuth	[0 3600]	-32768	0.1
sigma0_flag	[0 2147483646]	-2147483648	1

***wvc_sigma0 (dB) = 10*log10(abs(wvc_sigma0)), the sign is indicated by the bit-13 of the sigma0_flag**

The variable sigma0_flag consists of a set of useful flags, as shown in the following table.

Bit	Name	Definition
20	polar	0 for HH polarization, 1 for VV polarization
19	atten_map	attenuation map data not available
18	ice_map	ice map data not available
17	ice	ice presence
16	land	land presence
15	usability	sigma0 measurement not usable
14	noise_ratio	low signal to noise ratio
13	negative	sigma0 is negative
12	range	sigma0 outside acceptable range
11	pulse	pulse quality not acceptable
10	convergence	location algorithm does not converge
9	freq_shift	frequency shift beyond range
8	temperature	spacecraft temp beyond range

7	attitude	no applicable attitude records
6	ephemeris	interpolated ephemeris data
5	outer	outer swath
4	aft	sigma0 cell is aft of spacecraft
3	low_res	low resolution - whole pulse data
Others	Reserved	Default